THE ROLE OF THE NATIONAL PARASITE COLLECTION IN VETERINARY PARASITOLOGY

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Almost every individual during his lifetime has at least once become a collector of objects purely from curiosity or for the love to determine the quantity and variety of objects which can be accumulated. Naturally, pride is taken in the collection and in its exhibition. This is probably the way natural history collections first began, and no doubt many individuals still think of them in this light. Many collections, however, now constitute working tools in research as essential as are the experimental animals or laboratory equipment used. Among these is the parasite collection herein discussed. It was primarily started, and is still used today, to determine what parasites cause disease, their geographic distribution and animal hosts, and the diagnostic characters by which the parasites may be identified, including their various immature forms. This information is essential for treatment, control, quarantine, and research purposes. The collection is described herein, along with an index to the literature on parasites with which it is used, and some examples are given of its current and future roles as a working tool in veterinary parasitology.

Parasite Collection And Index To Parasitological Literature

Animal disease workers in the U. S. Department of Agriculture recognized the need for a parasite collection and index to

the literature on parasites over 76 years ago when they established the National Parasite Collection and the Index-Catalogue of Medical and Veterinary Zoology. The latter is a compendium of the world's literature on parasitology. Both of these working tools are maintained at the Beltsville Parasitological Laboratory where they are used by the some forty scientists at the Laboratory, as well as many visiting scientists. The records of the Collection enable investigators to find quickly essential information on the parasites deposited therein; the Index-Catalogue serves the same purpose with respect to the world's literature on parasites. The history of the Collection and a detailed description of the various parts and publications of the Catalogue are given elsewhere (Becklund, 1969a, b).

The Index-Catalogue consists of an Author Catalogue, and four Parasite-Subject Catalogues, namely: Parasites (subdivided by taxonomic groups), Hosts, Subject Headings (e.g., biochemistry, cultures, immunology, etc.), and Treatment. All information is recorded on 3″ × 5″ cards which are filed in approximately 1500 drawers. Over 100 publications comprising more than 20,000 pages have been issued under the title Index-Catalogue of Medical and Veterinary Zoology.

The Collection is composed of parasitic protozoans, cestodes, trematodes, nematodes, pentastomes, lice, mites, ticks, and other miscellaneous parasites. Approximately 65,000 lots, consisting of one to many specimens each, have been accessioned. Most of the specimens were collected during research and regulatory activities of the U. S. Department of Agriculture and state animal disease agencies. The procedure for the deposit of specimens in the Collection, so that they, and all information about them, can be easily found, is as follows:

1. All pertinent information on the name of the parasite, host, location in or on the host, geographic locality in which collected, and collector's and identifier's names and dates are recorded on accession numbered (Collection number) forms; this information is also recorded by Collection number in books and on labels that are placed with the specimens. 2. Each lot of specimens is assigned a storage number which designates its location in the Collection, and this number is recorded with the

aforementioned information. (Most liquid preserved material is stored in two-ounce square bottles in numbered wooden racks holding several bottles. Slides are stored in numbered wooden boxes holding 25 slides each.) 3. A Parasite Index and a Host Index are maintained on cards by recording, for each lot of specimens, the name of the host, Collection number, and storage location number under the name of the parasite in the Parasite Index; and the name of the parasite, Collection number, and storage location number under the name of the host in the Host Index.

Current Uses Of The Parasite Collection In Veterinary Parasitology

The Parasite Collection is a depository for specimens that have been mentioned in published reports. Specimens designated by authors as type material, as well as those that represent new host and distribution records or various forms in the life cycle of a species, are regularly deposited. In addition, the Collection and its records serve scientists in various ways. The following are a few examples:

Description of new species from man and animals: The thousands of authoritatively identified specimens in the Collection are invaluable for comparative purposes to determine species that are new to science. Several hundred new species of parasites have been described by U.S.D.A. scientists. During the last five years the Laboratory's personnel have described new species from various hosts, including man, marmoset, mountain goat, deer, alpaca, vicuna, and an African lizard. Among these, the species described from man is particularly important. It has reportedly caused over 900 cases of human capillariasis in the Philippines, some of which were fatal (Chitwood, *et al.*, 1968).

Provide information on the parasites of domestic animals in North America: A checklist of parasites of domestic animals in the United States and Possessions, and Canada, was prepared in 1945 (Dikmans) and revised in 1964 (Becklund). It was prepared for use in teaching, in research, and in regulatory quarantine activities from information in the Collection records

and Index-Catalogue, and by examining many specimens on deposit. This checklist gives the common and scientific names of the parasites, location in or on the host, intermediate hosts in the life cycle, if any, and geographical distribution. One hundred and twenty-one species of parasites were listed from cattle, 119 from sheep and goats, 92 from equines, 72 from swine, 132 from dogs and cats, and 179 from chickens, turkeys, pigeons, pheasants, ducks, and geese.

Provide information on ticks of veterinary importance on imported animals and items: For many years ticks that were removed from domestic animals, exotic wild animals, and items offered for entry and imported into the United States were identified and deposited in the Collection. Many of the ticks are of medical and veterinary importance; therefore, the species, hosts or items on which they were found, origin, and locality where collected, were recorded for regulatory and research purposes (Becklund, 1968). The ticks were removed from cattle, horses, numerous kinds of zoo animals ranging from hedgehogs to elephants, beef, cattle hides, palm leaves, mailbags, medicinal herbs, bird guano, and hair, from many parts of the world. This study revealed that: (1) The ticks represented nine genera and 37 species; (2) most of the exotic ones were males; females apparently drop off at foreign quarantine stations and while the imports are en route; (3) native as well as exotic ticks on imported animals can be vectors of exotic diseases; and (4) harmful ticks can occur on unexpected strange items and abnormal hosts.

Provide specimens to establish differential characters to distinguish between species: American sheep are hosts to several species of thread-necked strongyles. The various species are very similar, morphologically, and have been confused with one another for more than 70 years. Reports of the pathogenicity, treatment, incidence, hosts, etc., of the various ones are therefore questionable. A study of hundreds of specimens of these worms comprising 90 lots of specimens in the Collection revealed that instead of two common species and three rare ones, American sheep are parasitized by three common species and three rare ones. This study of specimens enabled investiga-

tors (Becklund and Walker, 1967) to establish morphologic characters to readily identify the species and determine their geographic distribution. Subsequent work with additional specimens from the Collection (Stringfellow, 1968) revealed a hitherto unrecognized structure of the worms that is useful in their identification.

Provide information on the probable transmission of parasites between domestic and wild animals: Parasites in the Collection and information in the Index-Catalogue were used to supplement findings from a study of the parasites found in 18 bighorn mountain sheep in Montana (Becklund and Senger, 1967). The known number of bighorn sheep parasites was increased from 34 to 51 species. Thirty-six of these 51 species are known parasites of domestic sheep and 18 parasitize cattle in North America. Thus, in regions where these animals graze on the same range land, parasites are probably interchanged between bighorn sheep and domestic sheep and cattle.

Provide specimens used to evaluate malformations in parasites resulting from an antiparasitic chemical: At necropsy, sheep suffering from haemonchosis and receiving therapeutic doses of phenothiazine had numerous deformed male specimens of the large stomach worm (Becklund, 1960). The percentage of deformed male worms in populations exposed to the drug ranged from 0 to 47 percent, whereas the percentage in unexposed populations, many of which were obtained from those placed in the Collection from 1900 through 1939, before the advent of phenothiazine, ranged from 0 to 0.3 percent. The parts of the worms affected, because of their prominence and normally characteristic conformation, are used in systematics; consequently the antiparasitic somewhat weakens current competence to distinguish species. In some respects, the deformities studied are similar to those recently reported in human medicine involving thalidomide.

Future Uses Of The Parasite Collection In Veterinary Parasitology

Parasitologists hope to rear parasites through their entire life cycle without the host (*in vitro* cultivation). Great strides

have been made recently along this line of research and nematodes of domestic ruminants have been reared *in vitro* from the eggs to adults (Leland, 1967). Parasites so reared are unique and should be compared with specimens from animals to establish their normality before their cultivation is considered a complete success. Because of their uniqueness, and the possibility of correlating their structure and development with nutritional deficiencies in the culture media, representative specimens have a place in the future of the Collection. This was recognized by Schiller (1965), who has deposited *in vitro* reared specimens and indicated their Collection number in his report.

Events of the past strongly suggest that the Collection will continue to be an essential working tool. Specimens will probably be needed for the evaluation of any change in morphology, pathogenicity, or host of parasites. Such changes could result from research activities, such as the use of X-irradiated larvae to produce immunity in animals, or from adverse environmental conditions which affect the host or the parasite, such as pollution, pesticides, or radiation. Hence, a problem today is deciding what kind and how many specimens are needed to fulfill future needs.

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